

NANOMATERIALS

Nickel ENMs Activate HIF-1 α

The health record of nickel, a known carcinogen, is far from shiny. Now the metal's reputation has been further tarnished with the discovery that nano-scale nickel triggers a cellular pathway linked to cancer much more effectively than larger particles do.¹

Engineered nanomaterials (ENMs) typically measure less than 100 nm in at least one dimension. Their minuscule size gives them novel physical and biological properties, and, being manufactured in a wide range of chemical compounds and shapes, they have applications in numerous fields.² Nickel nanoparticles are used in catalysts, sensors, energy storage devices, and other products, although they are not yet made in great quantity. "It's essential to study the toxicological properties so we understand them before they become widely used," says Jodie Pietruska, a postdoctoral researcher at Brown University in Providence, Rhode Island, who led the new study.

Nickel is a well-known occupational hazard.³ In rodent studies, nickel nanoparticles instilled in the trachea and lung caused greater toxicity and inflammation than larger particles,^{4,5,6} and inhaled nickel nanoparticles caused signs of vascular disease.^{7,8} Brown University pathologist Agnes Kane coauthored a 2007 paper showing that, compared with larger micron-scale nickel, nickel nanoparticles release nickel ions more rapidly, a mechanism characteristic of carcinogenic nickel compounds.⁹

To further connect the dots, Kane, Pietruska, and colleagues conducted a series of experiments comparing the behavior in human lung epithelial cells of nickel oxide and pure metallic-nickel nanoparticles with larger metallic-nickel microparticles.¹ They detected nickel ions inside lung epithelial cells exposed to nickel nanoparticles but not to nickel microparticles. And they showed that exposure to the nanoparticles, but not the microparticles, activated the HIF-1 α cellular pathway, which is thought to be involved in carcinogenesis and tumor progression.

The researchers also found differences in overt toxicity of the various forms of nickel, with the nanoparticles killing the lung epithelial cells quickly and the microparticles having little effect. Intriguingly, in toxicity as well as in ion release and activation of the HIF-1 α pathway, nickel oxide was much more active than metallic nickel. Pietruska and Kane speculate that metallic nickel may be the more carcinogenic nanoparticle, because it seems more likely to let cells survive long enough to develop cancer. More research is needed, ultimately in live animals, before nickel nanoparticles can definitively be said to cause cancer.

Vincent Castranova, coordinator of nanotoxicology research at the National Institute for Occupational Safety and Health, says the finding has implications for agents besides nickel and reinforces the prediction that many ENMs will have greater biological effects than their larger-form counterparts. "It's an important finding, but it's not a surprising finding," he says. "It confirms what would have been our suspicions."

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The Beat

by Erin E. Dooley

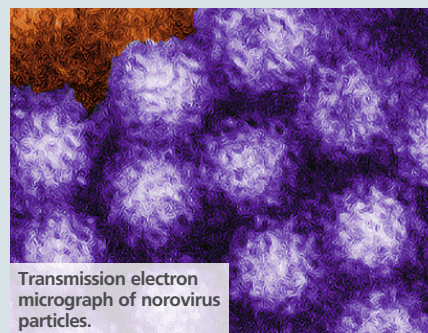
Scientists Investigate Burned Gulf Spill Emissions

Much of the oil spilled during the BP *Deepwater Horizon* disaster in the Gulf of Mexico was burned to keep it from reaching the shoreline or harming sea life. NOAA scientists have analyzed the gas and aerosol emissions resulting from the burning of the spilled oil and found that over a 9-week period more than 1 million pounds of black carbon were generated, roughly the amount

emitted in the same period by ship traffic in the region.¹ Compared with ship emissions, the particles generated by the oil burning rose to higher altitudes but also were larger and attracted fewer other substances, which may shorten their lifetime and make them less of a health and climate threat. These findings could be used by decisionmakers to help assess the tradeoffs of various response strategies during future disasters.

Norovirus Persists in Groundwater

A new study has shown that norovirus in groundwater can remain infectious for an unexpectedly long time—at least 61 days.² With symptoms that include diarrhea and vomiting, norovirus causes more than 20 million cases of gastroenteritis in the United States each year, according to CDC estimates.³ The virus, which can enter groundwater via leaky sewer pipes or septic tanks, is best removed from drinking water using nanofiltration, reverse osmosis, distillation, or ultraviolet treatment; chemical treatment is only moderately effective.⁴



Transmission electron micrograph of norovirus particles.

NNI Updates Nanotechnology Research Strategy

The multiagency National Nanotechnology Initiative has released an updated strategy document that identifies key environmental, health, and safety research needs in regards to engineered nanomaterials (ENMs) and the products that contain them.⁵ The document focuses on six core research categories to help guide the responsible development of nanotechnology: nanomaterial measurement tools and protocols, human exposure



Oil from the BP *Deepwater Horizon* disaster during a controlled burn, 6 May 2010.

NATURAL RESOURCES

NY DEC Takes on Fracking

New York is one of a handful of states (others include New Jersey, Maryland, and North Carolina) that have banned hydraulic fracturing, or “fracking,” pending further study and scientific review. A key element of New York’s review is the Supplemental Generic Environmental Impact Statement (SGEIS), a 1,537-page document drafted by the state’s Department of Environmental Conservation (DEC).¹ The SGEIS was issued in September 2011 with a comment period that closed December 12. No fracking permits have been approved in New York, and none will be until the SGEIS is finalized, according to Emily DeSantis, the DEC’s assistant director of public information.

DeSantis says fracking’s public health impacts were “fully considered” in the draft SGEIS. But a letter sent to New York governor Andrew Cuomo on October 5 and signed by more than 250 health and environmental professionals and groups claims otherwise.² “The SGEIS contains no human health assessment at all,” says Sandra Steingraber, a distinguished scholar in environmental studies and sciences at Ithaca College. In the letter, signatories including Steingraber asked the DEC to conduct a supplemental analysis of baseline human health status in New York, a systematic identification and review of direct and indirect health effects of fracking, a cumulative health impacts analysis, and potential measures to eliminate those impacts.

“Scientists increasingly say there aren’t enough baseline data to draw firm conclusions about fracking’s health risks,” says Christopher Portier, director of the National Center for Environmental Health and Agency for Toxic Substances and Disease Registry of the Centers for Disease Control and Prevention. “But work done at various sites by state and federal authorities suggests additional research and analysis is warranted.” (Portier was not a signatory to the letter.)

Fracking is a method for liberating natural gas from shale rock deep underground. It generates wastewater polluted with heavy metals, salts, radionuclides, and other hazardous compounds leached from subsurface rock. Anecdotal reports of illness related to fracking operations abound, but they aren’t tracked systematically such that scientists can investigate links to specific exposures, says Robert Sweeney, chairman of the New York State Assembly Standing Committee on Environmental Conservation. Sweeney has called on New York’s state agencies to establish a registry for monitoring allegations of health issues.

But Jeffrey Gordon, director of public affairs with the New York State Department of Health, says such a registry isn’t necessary. “[This department] already has several ongoing health registries, such as the cancer, birth defects, and heavy metals registries, and other ways to access health data—for instance, from hospital admissions,” he says. “The state and county departments of health will investigate complaints of exposure to chemicals used in [fracking].”

“DEC’s focus is on preventing exposure,” says DeSantis in response to the October 5 letter. “If there are no pathways of exposure in the first place, then adverse health impacts cannot occur.” The DEC recommends a 2,000-foot setback between fracking operations and public water supplies and proposes that watersheds associated with unfiltered water supplies to New York City and Syracuse—in addition to wildlife management areas and primary aquifers that supply groundwater for human consumption—be off limits to drilling.¹ State officials had no further comment on the letter or the degree to which human health concerns from fracking will be evaluated.

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assessment, human health, environmental fate and impact, risk assessment and risk management, and informatics and modeling. The emphasis on informatics and modeling, new for this update of the strategy, reflects the need for a way to organize the rapidly growing wealth of data on ENMs.

Help for Disease-Stricken Coral Reefs?

Coral reefs sequester carbon dioxide, support fisheries, protect the coastline from storms, and help generate tourism revenue. But reefs around the world are being compromised by changing ocean waters and further threatened by opportunistic pathogens such as *Serratia marcescens*, which causes white pox in Caribbean corals. Researchers have discovered that a cocktail of other bacteria isolated from Caribbean reef tracts, when administered under laboratory conditions, helped prevent white pox disease progression in the polyp *Aiptasia pallida*, a coral cousin and surrogate model for coral research.⁶ The researchers believe it may be possible to use

beneficial probiotic-like bacteria as a tool for the proactive management of coral reefs.

EPA Announces Final Plan to Assess Fracking Impact on Water

After months of public meetings and a review by the agency’s independent Science Advisory Board, the EPA recently announced its final research plan for hydraulic fracturing (“fracking”).⁷ The study plan encompasses the full cycle of how water is acquired, used, and

disposed of during fracking. The initial research results and study findings will be released in 2012, with a final report expected in 2014.

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A natural gas rig near Rifle, Colorado.